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TITLE: Soldier Feedback for Better Products

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ABSTRACT:

Food, clothing, equipment and shelters impact on soldier performance and morale in the field. If any of these basic, crucial commodities are aversive or, even worse, not supplied by the system, soldier effectiveness can be impaired.

Three years ago Natick Research, Development & Engineering Center created a program to obtain soldier feedback on these battlefield basics so that it could measure product efficacy, remedy deficiencies, and identify unmet needs. The program is based on world-wide surveys of combat arms units and the subsequent channeling of information to product developers and administrative personnel. This program is augmented by interacting with Central Issue Facilities, briefing command and staff of Army divisions, conducting user evaluations, and operating a "hotline."

This feedback model is effective. It has spurred design changes and identified the need for policy changes in issue and use of products. Most importantly however, it has given the Center and product developers substantive data bases for their products to use in the decision-making process.

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SOLDIER FEEDBACK FOR BETTER PRODUCTS

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Introduction

The human factors textbooks contain two commandments for any developer wanting a successful product:

1. Know your user.
2. User-test your product in all its life cycle stages.

However, just like a more famous set of 10 Commandments, these two are also broken.

Although the military has been much more responsive than the civilian world to the need for user testing and the application of other Human Factors precepts, its efforts have been primarily centered in a few major systems and product areas.

This situation is now changing. Design errors that resulted in aircraft begging for pilot error, weapons systems outstripping soldier ability, and unforgiving computer systems have spurred programs that comprehensively integrate the soldier-user in the design loop for all products in all phases of the procurement process.

Although weapons and aircraft have been the attention getters in design issues, Natick's products -- rations, environmental protection items, clothing, shelters, and airdrop systems -- also demand an uncompromising application of various human factors principles. Natick too has to target the soldier's physiological and psychological parameters in order to assure soldier acceptability of its products.

Acceptability is one of the critical human factors issues for Natick items, as a soldier simply will not use an item he or she finds unacceptable. An unused item equates to the soldier lacking a battlefield advantage and wasted money. The staggering costs of Natick's items startle those who have only heard the litany of weapons dollars. For instance, the 1987 procurements for just the Meal, Ready-to-Eat, Battle Dress Uniform, Combat Boot, Jungle Boot, and the General Purpose Medium Tent amounted to $395 million -- and those items are usually procured annually.

Three years ago Natick responded to the prevailing human factors climate that pressed for broad user - that is, soldier - interface in product assessment. It launched a program dedicated to this purpose called OFIG (Operational Forces Interface Group). This program slightly predated the service-wide programs such as the Army's MANPRINT and Navy's HARDMAN, which mandated, among other things, a systematic human factors approach in the development of new military products or systems.

Although product developers -- civilian and military -- are aware they must user-test, there are few available models to go by. While there is much literature on research design, there is little that offers a "cook book" schema for implementing a structured program in an organizational setting. Even the MANPRINT program at this point has left it to the various Army organizations to wrestle with the personnel, organizational, and fiscal issues surfacing with putting its mandates into effect.

The OFIG program is still expanding and coordinates with the Natick's MANPRINT program. It has proved workable as well as beneficial. We would like to describe its operations, accomplishments, and insights with the hope that other organizations embarking on similar paths can benefit in some measure from our observations and experiences -- both good and otherwise.

Operational Forces Interface Group - A Case Study.

Organization and Personnel.

Natick is fortunate in that its structure and mission allowed for an easy birth of a user product assessment program. All the different skills and talents needed were already available on site. Product assessment demands a marriage of product expertise with research skills. The product experts know the "what" that has to be researched, and the researchers have the "how" of getting that information. Many project officers who have tried to test on their own have found themselves collecting data that cannot be analyzed because of inadequate test design. Researchers who have not worked closely with the product personnel have come up with either irrelevant or incorrectly interpreted statistics.

Natick assigned an equipment specialist and an Infantry officer from the Advanced Systems Concepts Directorate and a human factors psychologist and two technicians from the Behavioral Sciences Division, Science and Advanced Technology Directorate. That initial staffing provided a blend of research and product expertise, plus a military member who could help access the military user. Program personnel also had ready access to project officers and extra help when needed from a staff statistician. The number of personnel grew as the program grew, and currently there are seven plus clerical support.

Organizationally the members of the two directorates collaborate closely, but at this point are subsets in their respective directorates, and each subset answers only to its management chain. Moreover, all personnel are in directorates that have support functions, and not in those responsible for any products. This reduces bias in product assessments, unconscious or otherwise.

User Surveys

OFIG plunged into the user world by surveying soldiers in the United States and overseas on Natick's many fielded items - with the surveys including both questionnaire and interview efforts. Natick has an extremely large materiel inventory and wanted the products in it to be the first priority in obtaining user feedback.

The surveys are a major undertaking. Proceeding through military channels, OFIG schedules five to eight trips a year to combat arms divisions that have just returned from major training exercises in harsh environments such as the desert, jungle, or where the weather was extremely cold. There were two rationales for this approach. The immediacy of the visits means that use of the items is fresh in mind, and the environmental harshness tests the level of abuse the items can withstand. Between 250 and 400 soldiers are surveyed on each occasion.

The products chosen for the surveys are selected from lists requested from the product directorates. OFIG crosschecks these against what the military units have used. It also adds to the list any item it feels should be included.

No item is surveyed without first consulting with the project officers. They are the best source of information about the product and their input is the backbone of the questions asked. This base is then fleshed out with whatever questions are necessary from a human factors perspective. When the questionnaire is in final draft, it is returned to the project officer for review.

To date the surveys have provided many solid and extensive data bases. OFIG has surveyed over 6,000 soldiers both in the continental United States and overseas. Some commonly used items are routinely surveyed; those used less or in a more limited fashion are correspondingly surveyed less often.

Besides the obvious payoff in specific product information, there are other rewards to systematic surveys. One is that a quantified data base provides a frame of reference for product complaints. When a problem with a product is mailed or called in from the field, OFIG can determine whether it's an isolated defect or not. Conversely, a complaint can generate an item's being included on a survey if there are no appropriate data available.

Also, systematic surveys allow the luxury of zeroing in on a problem. For instance, the first time a product appears on a questionnaire the questions are rather broad, as there is no way to anticipate the details of every contingency or issue that may arise. This means that the nature of a problem area will surface, but not necessarily the details. On the next survey the detailed questions can be added.

OFIG also uses the questionnaires and interviews to provide a clearer picture of the user. They are laced with questions about their mission requirements, garrison and field life, and even extend to hygiene and eating habits. In short, OFIG asks anything that bears directly or indirectly on product design.

User Evaluations

After the survey process was fully operational, OFIG extended its sphere to user field tests of developmental or modified items and in three years has evaluated 25 products and systems. This part of the program was, and is, its most challenging -- field testing is brutal! While field testing is the true test of a product, it is also testing that allows for less scientific control. It sometimes also has to take an expedient path because of the eternal and ubiquitous manpower and money constraints. Critics might counter that any field testing that does not allow for a full-scale, rigidly controlled regimen might produce erroneous data. That may be true, but a highly controlled test is also subject to error. In any event reality shows that there is hardly a product that will be funded for full-scale, highly controlled testing at every step. Even if the ideal testing scenario were always possible, another problem would then arise -- that of frequent interference in military operations in the field. In any event, OFIG has not found erroneous data a problem, and feels that much can be gained from field evaluations in spite of their drawbacks.

OFIG uses a number of testing procedures. The simplest is to deliver an item to a user for a preordained time period. (This means that no more than a few are available.) At this stage the only goal is to identify any gross defects in design or functioning. OFIG has found that major problems emerge in the span of one or two field exercises. Any necessary modifications can then be made, and the next evaluation will be more comprehensive.

This type of evaluation is low cost. No large amount is spent to produce large numbers of a conceptual item, and testing is "piggybacked" onto a more comprehensive test or survey effort. Even at this stage field testing can deliver vital information that the laboratory cannot.

A specific instance is a recent evaluation of a prototype Combat Vehicle Crewman's Equipment Bag. This bag resembles a field pack with no frame, intended to hold field gear and designed for tank transport. OFIG delivered the one existing bag to members of an Armored Cavalry unit in Europe while on a survey trip and retrieved it 90 days later while on another evaluation.

OFIG interviewed the five personnel that had used it on a number of field exercises and sent their comments to the project officer. The soldiers found it very acceptable for their mission and felt it would make functioning in a tank easier, as it created more space by consolidating gear. Their one complaint was that it didn't have enough compartments; they wanted immediate access to some items when they had to "move out." None of this information would have surfaced from laboratory testing.

The other end of OFIG's field testing methods can be illustrated by a recent glove evaluation, which supported the Army's quest for a warmer glove for a moderately cold climate. It was conducted at three bases in the United States and one overseas and involved a total of 1400 soldiers who were assigned to either a control or experimental group. At the outset, the test soldiers were carefully fitted with the gloves and instructed on test protocol. At the end, data were collected on over 20 variables, and supportive weather and mission data were also obtained. This was costly, but nothing compared to what the procurement of an inadequate product would exact in either dollars or dismay.

Most user evaluations fall at some point on the range bounded by the two extremes just described. The most common scenario is to have a product evaluated at one site, with approximately 30 to 60 users in both control and experimental groups.

In addition to the product information delivered by these user evaluations, benefits occur in terms of manpower and money when tests can be overlapped or piggybacked. By having test efforts coordinated through one office instead of having each project officer operating independently, fewer travel dollars are spent overall, and many manhours of coordination can be saved.

Other User Feedback

Although surveys and evaluations are the mainstays of OFIG's data base, it is not confined to them. Other endeavors also help open communication lines and broaden its knowledge of Natick's products.

For the most part, combat arms personnel have no clear picture of the structure and responsibilities of their logistical support agencies. OFIG has therefore made it policy to give users a formal, comprehensive briefing on Natick and a demonstration of its new and developmental products. Soldiers then know what products Natick is responsible for, what new ones they will be getting and when, and whom to turn to with problems, suggestions or needs. These briefings are given to survey personnel, test personnel, and the command and staff of all divisions visited.

The briefings and demonstrations to the command and staff -- which include all levels from battalion to the division commander -- elicit broad feedback on how Natick's items and systems are functioning. These high-ranking military are extremely interested in Natick's products and also help to facilitate future survey visits and user evaluations.

The feedback loop also extends to central issue facilities (CIFs). These organizations operate at every military base and their function is to maintain, store, and issue field equipment and clothing. OFIG calls on the manager at each site it visits and interviews him or her to find out how Natick's products are performing, and at the same time inspects the equipment.

OFIG also advises CIF personnel on proper issue and care of products. For instance, survey data were showing that soldiers were not being fitted properly for the PASGT helmet - the standard helmet that replaced the old "steel pot." Improper fit affects safety. OFIG has therefore trained CIF personnel on the proper sizing techniques and sent the proper equipment (for example, calipers) when necessary.

OFIG also maintains a telephone hotline. It informs all users of its existence in the course of its briefings, leaves cards and posters with the number at military bases, and advertises it in military publications.

One last effort OFIG makes to close the developer-user gap is to include project officers in its visits to the military bases. A number of them have taken advantage of the opportunity and have returned with a better sense of what requirements their product has to meet and how the military community operates. Project officers are also apprised of a government program which allows them to participate in field exercises as a temporary member of a platoon or other unit. They must meet age and other physical requirements, so not all are eligible. Those who have participated have found it an invaluable experience.

In-house Communications

Good communications are a key to any successful operation and OFIG has made every attempt to communicate effectively in-house both in terms of its mission and the circulation of user feedback data.

OFIG's initial communications were devoted to informing all Natick personnel of its existence and its mission. It circulated memoranda explaining what it could do to help project officers in obtaining user feedback on their products and then later on how it could help with their field test requirements. It also briefed all center directors individually at the outset of the program and has held a series of briefings over the past two years for the project officers to provide them a forum for a give-and-take exchange.

A report stems from every survey trip and user evaluation. Each is circulated not only to management and item project officers, but also to anyone that could conceivably benefit. That includes those responsible for similar products or those who have to assess factors such as their product's compatibility with the products in the report at hand.

Natick requires a trip report be filed for every trip taken. This is the vehicle for communicating feedback obtained from commanders and staff of military units, CIF personnel, and other sources in the user world. Trip reports are also circulated to all who could possibly benefit from the information.

Discussion

Overall Program

OFIG is not yet fully evolved. It has continued to grow in both personnel and responsibility during its existence. It has just been designated officially as Natick's test coordination office and all project officers must apprise OFIG of any intended field testing. Up

to this point, while many have availed themselves of OFIG's program, they were not required to do so. This procedure should be beneficial in terms of product tracking, manpower, money, and information flow. It does not, however, mean that OFIG will be conducting all field testing. Other Natick organizations conduct the large-scale, data-intensive efforts that require field residence; OFIG will merely track these evaluations. For the lesser efforts it will assume an advisory role when it does not have the personnel available to conduct them.

However, questions are starting to be raised at this stage in a testing program's evolution. For instance, how much can be committed to a testing program in personnel or funding? While there is no doubt that testing must be conducted early in the design cycle to offset greater costs that would be incurred if design changes had to be made late in the development cycle, there are still decisions to be made as to what scale and how often testing should be conducted for a particular item in order to be the most cost effective.

The user surveys also are starting to raise questions. How often does an item have to be surveyed to most effectively pick up on problems in manufacturing or basic design issues? What really constitutes a solid, reliable data base for a product given the myriad of career fields that use it and the number of environments in which its used? In other words, which cost benefit ratio in obtaining user feedback is the most advantageous? The attempts at answering these types of questions will most certainly be responsible for shaping OFIG's future.

Survey Techniques

The importance of a well designed questionnaire cannot be emphasized enough. A well constructed questionnaire provides the best chance for obtaining good, analyzable data. Proper construction demands a knowledge of a number of techniques, among them scaling and question structure. The literature offers much help in this regard.

A questionnaire also has to use appropriate user language or data can be lost. This applies to reading level and terminology. OFIG has to keep its questionnaires at sixth grade level, which it assesses by processing them through canned software programs. Terminology is also tricky; OFIG has found the hard way that the soldier and the Center often use different words for the same items. For example, the center says "PASGT" helmet where the soldiers say "Kevlar" helmet. OFIG's frequent forays into the user environment has been invaluable for learning user language, but nonetheless it remains vigilant in this area. The assumption that users will ask about what they don't know or understand is a false assumption. Many soldiers do not like to draw attention to themselves, and will leave items blank or fill them in incorrectly rather than ask a question.

Questionnaires cannot be too long. Thirty minutes is about the maximum time our users will give one their full attention. This translates to five or six 8½" X 11" pages with questions on both sides and generous spacing.

Product Evaluations

The two greatest lessons in this aspect of the program were that the user unit's command support is critical to the success of the evaluation and that even under the best of circumstances, subject attrition is appalling.

OFIG has learned to ask for at least twice the number of participants any test design would normally require. It also asks for hand receipts for the test products, puts requests to units for test support in writing, and directs these requests to a command level no lower than division.

In spite of these procedures, data acquisition can be problematic, and has had to be pursued relentlessly. In most cases the problem stems from the fact that there are many mission requirements in the field and upon returning from it. Access to the soldiers for purposes of collecting data becomes a lower priority than tanks that require maintenance or some other pressing mission demand.

The survey efforts are less of a problem in terms of support because they can be planned a year or more in advance. With a long lead time Natick can request access to users through a very high level troop command, and since these requests filter down through the combat arms chain, they have a higher priority.

A third lesson OFIG learned in field testing was to keep test designs simple. With the pronounced lack of control in a field situation the simpler design will fare better.

Communications

The reports that OFIG generates for in-house use are written informally and for an audience that is assumed to have no knowledge of statistics. Tables and graphs are kept to a minimum. The statistics used in most analyses are simple and primarily descriptive, but even so OFIG will even report means without including standard deviations. Most of the nonstatistical world — and that includes many scientists and engineers — does not have a complete grasp of either descriptive or inferential concepts. OFIG therefore strives for easy readability and includes a point of contact in each report for those who want more statistical detail.

Program Tools

This past year the Science and Advanced Technology Directorate acquired an optical scanning system which OFIG now uses for its questionnaires: a Century 3000 optical scanner configured with an IBM PS-2, an Apple McIntosh SE, and a Texas Instruments Omni Laser Printer. The Apple and IBM both have dedicated software. It is a flexible, state-of-the-art system and has saved considerable time.

Conclusion

At this point OFIG has a workable, productive program for obtaining user feedback. It has incorporated the user at all levels and in all combat arms branches. It has a number of vehicles for obtaining user information, that is, surveys, product evaluations, interaction with unit commanders and their staffs, interaction with CIF's, and a hotline. It has effective in-house communication strategies.

Because this program is responding to the needs of a unique military multiproduct developer, it can hardly be considered a general model for obtaining user feedback. OFIG does, however, hope that its program will provide a frame of reference or at least a starting point for others who are looking for ways to involve the user in product feedback.